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CONDITIONED COPPER DEFICIENCY IN SHEEP AND CATTLE IN BRITAIN*

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This paper reviews observations made in the Biochemistry Department at Weybridge, in collaboration with various veterinary colleagues, on disorders associated with low copper status in sheep and cattle, reflected by low copper values of blood and liver, irrespective of the copper content of the pastures over which they graze. The data are discussed in relation to results reported from Australia and New Zealand. Most of the work has been published already but some of it is new and has not yet been reported in detail.

The phrase "conditioned" copper deficiency is used to distinguish from "simple" copper deficiency. In the latter the deficiency arises from lack of sufficient copper in the diet. In the former some other factor is present which disturbs the metabolism of copper in the body even on diets containing normal amounts of the element. Historically the associated clinical disorders were observed first in sheep and later in cattle and the observations are therefore taken in that order.

SHEEP

The disease "neo-natal ataxia of lambs" has been known for many years under a variety of names such as "swayback," "swingback," "warfa" and others and has a wide geographical distribution throughout England, Wales and Scotland. A pathologically similar disorder known as "enzootic ataxia" occurs in Australia and New Zealand and has been described by Bennetts and his colleagues (1937 and 1942) and by Cunningham (1946).

Although the disease has a wide distribution throughout the country the incidence varies from year to year on the same farms and in the same districts, but there are some areas, such as parts of Derbyshire, where it occurs year after year, the only variation being the percentage of lambs affected each year. Before prophylactic measures were taken the mortality in severely affected areas varied annually from 5 to 50 per cent. of the lambs born. Ewes of any age or breed may give birth to ataxic lambs, and ewes which produce affected lambs one year may produce normal lambs the next, but in our experience occurrence of the disease is broadly related to length of sojourn on "affected" farms. Observations made in Derbyshire over a period of six years showed that no ewe which had been on an "affected" farm for less than one and a half years gave birth to an ataxic lamb.

Symptoms and pathology have been comprehensively described by Innes and Shearer (1940) and may be briefly summarised as follows: There appear to be two types of the disease, (1) the common acute form in which the lambs are affected when born and (2) a "delayed" type which may develop as late as three months after birth. In both, however, the symptoms are essentially those of a spastic paralysis, particularly of the hind limbs, and vary only in degree of severity. All cases show inco-ordination of movements; severe cases are unable to stand or walk, others may rise and walk with difficulty, while mild cases show only slight weakness of the hind quarters, particularly when made to move quickly.

Severely affected lambs usually die shortly after birth but mild cases, usually of the delayed type which show only slight inco-ordination which does not progress, often survive, and when bred from later, may produce quite normal lambs. Mothers of affected lambs remain apparently healthy and show no clinical symptoms.

The disease is characterised pathologically by a diffuse symmetrical demyelination of the cerebrum, varying in extent from small foci in the *centrum ovale* to gross demyelination of the whole hemispheres with liquefaction and cavitation in extreme cases. Secondary degeneration of the motor tracts in the cord is always present.

Evidence at present indicates that demyelination occurs at a relatively late stage of gestation, probably within the last six weeks, *i.e.*, after cerebral myelination has begun. Romanes (1947) has shown that the first myelin appears in the forebrain of the lamb at 96 days.

Many attempts were made from 1932 to 1937 to transmit the disease and to isolate a specific organism from tissues of affected animals, but were all negative. In 1937 Bennetts and Chapman in Australia first showed that the disease was related to a copper deficiency of the herbage. Later Bennetts and Beck (1942) showed that blood and liver copper values of ataxic lambs and their mothers were extremely low and that the disease could be prevented by administration of copper to the ewe during the gestation period.

Subsequent work in Britain (Dunlop, Innes, Shearer & Wells, 1939; Innes & Shearer, 1940; Shearer & MacDougall, 1944; Eden, Hunter & Green, 1945) showed a similar low copper status of swayback lambs and ewes and it is now well known that the disease can be prevented by administration of copper sulphate to pregnant ewes.

In so far as blood copper values are concerned, a figure of about 1 mg. per litre may be regarded as a common normal for sheep and it is rare to find a ewe delivering a swayback lamb unless its blood copper is well below this. In Derbyshire by far the greatest incidence of the disease occurs in lambs from mothers with blood copper values ranging between 0·1 and 0·6 mg. per litre. The relationship, however, is complicated by various factors such as the wide variation of blood copper levels in individual members of flocks on farms with no history of swayback. This variation may be as wide as tenfold (Eden, 1941). The relationship between low blood copper values in ewes and occurrence of the disease in their lambs

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is a " one-way correlation." An individual blood copper value is, therefore, of no diagnostic significance and all that can be said is that if the blood copper status of a flock of ewes is low, a high incidence of swayback in their lambs is likely to occur. Since the liver is the main storage depôt for copper, liver copper figures give the most reliable index of the copper status of an animal (Cunningham, 1946; Loosmore & Allcroft, 1951) and whenever possible should be used in conjunction with blood copper values for diagnostic purposes. Although swayback and enzootic ataxia of Australia correspond very closely, there is the important aetiological difference that in Australia the disease occurs on pastures low in copper, below 5 p.p.m. on a dry matter basis, and commonly below 3 p.p.m., whereas in Britain it occurs irrespective of copper content and is prevalent in Derbyshire at levels of 7 to 15 p.p.m. or more. In Australia the disease has been attributed to a simple copper deficiency rectifiable by fertilising the soil with copper salts. In Britain another factor seems to operate, which either depresses the availability of the copper in the plant, or in some way interferes with copper metabolism in the animal itself.

The factor in the pastures which induces the disease in spite of normal or high copper content is unknown and there has been much speculation regarding its nature. Lead has been suggested because pastures in some areas where the incidence of swayback is high show a high lead content due to surface contamination from plumbiferous soils. The view has, therefore, been advanced that the complicating factor is a combination of high lead with low or moderate intake of copper. Observations at Weybridge showed that a daily dose of 50 mg. Pb, as the acetate, to hypocupraemic ewes did not increase the incidence of ataxia in the lambs, nor did a high lead intake produce hypocupraemia in sheep even when given in quantities ranging from 100 to 400 mg. Pb daily for as long as a year. Also, swayback occurs frequently in areas where the lead content of the pastures is normal.

Another suggestion put forward by Australian and New Zealand workers is that a combination of moderately high molybdenum with low or moderate copper content of pastures causes a " conditioned " copper deficiency in sheep and cattle (Dick & Bull, 1945; Cunningham, 1946 & 1949). Investigations at Weybridge have not so far confirmed these views in the case of *sheep* and indicate that molybdenum content of pastures in Britain bears no relationship to incidence of swayback.

This lack of relationship is shown in Table I in which is given the range of copper and molybdenum values of pastures on farms where swayback has occurred and on farms where it is not known. A further illustration is given in Fig. 1, which shows the effects of administration of relatively large doses of molybdenum over a period of 15 months to stalled sheep with a low copper status at the beginning of the experiment (average values for blood and liver being 0·2 mg. per litre and 15 p.p.m. on D.M. respectively). Not only did the high molybdenum intake fail to maintain the low copper status but permitted rise of both blood and liver values to normal levels. Since the number of sheep in this preliminary experiment was small (four plus two controls) and since both Australian and New Zealand workers have demonstrated that a high molybdenum intake reduces liver and blood copper in sheep and cattle, these observations are being repeated using a larger number of both copper deficient and normal sheep in stalls and at grass. Later Weybridge work has given similar results to those reported from Australasia in *cattle*. This will be discussed in more detail in the section dealing with copper-molybdenum relationships.

TABLE I
COPPER AND MOLYBDENUM CONTENT OF PASTURES IN RELATION TO INCIDENCE OF SWAYBACK

Area	Derby-shire	Bedford-shire	Somer-set	Wey-bridge
Number of farms	5	2	3	1
Pasture Cu p.p.m. on D.M.	7 – 20	8 – 18	7 – 18	7 – 20
Pasture Mo p.p.m. on D.M.	0·5 – 11 (4·8)	0·5 – 9 (2·5)	6 – 40 (25)	0·5 – 1·6 (1·2)
Mean blood Cu mg. per litre	0·5	0·5	0·8	0·8
Swayback incidence	30%	15 %	Nil	Nil

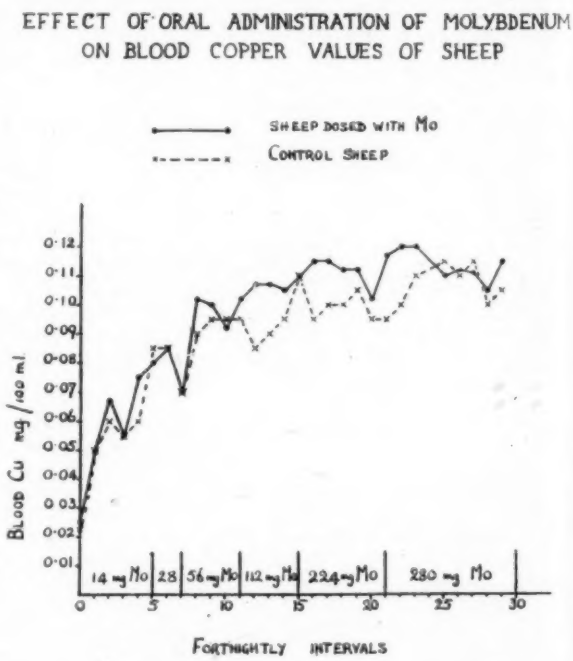

FIG. 1.—Mean fortnightly blood copper values for four barren stall-fed ewes dosed daily with sodium molybdate over a period of 15 months. The amount of molybdenum was increased at intervals throughout the period as shown. Also mean values for two control ewes throughout the same period kept under the same conditions.

CATTLE

It was not until 1946 that copper deficiency was suspected (Jamieson & Russell) and confirmed (Allcroft) in bovines in this country although it had then been known for eight years that swayback was associated with a low copper status of ewes and lambs. It is perhaps of interest to give a few details of these first observations (Allcroft & Parker, 1949).

The two farms on which it was first found are near the Shropshire-Cheshire border and are situated entirely on flat peat land just below sea level. Both are dairy farms, one quite small carrying only about 12 head of stock and the other about 40.

The main clinical features of this disorder were severe

chronic diarrhoea, especially during the flush growth of grass during spring and autumn, and unthriftiness. Because of the almost constant state of scour the cows were naturally in poor condition, with rough staring coats, and gave low milk yields, but it was in the young stock between weaning and calving that unthriftiness was most marked. These animals were severely stunted, so much so that the two-year-old heifers could be mistaken for 8- to 10-month-old calves.

It should, perhaps, be pointed out here that the clinical and pathological features of copper deficiency in the bovine are entirely different from those observed in hypocupraemic conditions in sheep. No demyelination disorder of calves has been observed and it is the growing and adult cattle which are affected while in sheep the adult ewe remains apparently normal.

Blood samples from both herds showed that copper values were very low, figures of 0·1 to 0·4 mg. per litre with a mean of 0·3 mg. per litre being found. A figure of about 1 mg. per litre may be taken as a common normal for cattle and anything below 0·7 mg. per litre can be regarded as low although clinical symptoms of unthriftiness are not necessarily associated with such levels.

Pasture samples taken from fields on both farms at intervals throughout the year gave normal copper values ranging from 8 to 23 p.p.m. on a dry matter basis with a mean of 14 p.p.m. Molybdenum values ranged from 2·3 to 7·4 p.p.m. with a mean of 4·4 p.p.m. These are slightly higher than the usual normal of 1 or 2 p.p.m. but do not approach the teart pasture values of 15 to 100 p.p.m. found in Somerset by Ferguson, Lewis and Watson (1943).

The herd on the larger farm consisted of about 40 animals of all ages with a fluctuating milking nucleus of about 26 cows. These were divided into three roughly equal Groups A, B and C and each group occupied a separate byre for milking or when stalled during winter months. Calves were kept inside until 8 to 10 months old but were allowed out for grazing when the weather was suitable.

Experimental treatment consisted of daily administration of copper and copper plus other trace elements to Groups A and B in the form of copperised cake or mineralised cubes. Group A was given 1 lb of anti-teart cake per head per day which supplied approximately 2 g. copper sulphate or 500 mg. Cu per day. Group B received ½ lb of a semi-proprietary brand of mineralised cubes per head per day which supplied approximately 160 mg. Cu plus 20 mg. cobalt and 60 mg. iodine as well as 21·6 g. calcium, 10 g. phosphorus, 12 g. sodium, 18·6 g. chlorine, 0·1 iron, 3·2 g. sulphur, 150 mg. manganese and 20 mg. nickel. Group C was given no mineral supplement and served as a control. The calves were left untreated.

Results on blood samples taken at monthly intervals over a period of 16 months showed that administration of copper to Groups A and B resulted in an immediate marked elevation of blood copper values and that elevation in Group A which received approximately three times as much copper as Group B was greater, as would be expected.

Improvement in clinical condition in the two treated groups was evident a month or two after commencement of feeding the copperised cake or cubes. The consistency of the dung became firmer and the previous persistent scouring was controlled. Improvement was most marked and rapid in Group A, which received the larger amount of copper, and throughout the experiment this group remained in a slightly better condition than Group B. This may have been due in part to the fact that the mineralised cubes given to Group B were not very palatable and the cows sometimes refused them even though they were given individually and mixed with concentrates and chopped roots.

The consistently low values obtained for the control Group C could be correlated with the continued unthrifty condition and diarrhoea in this group.

There was a slight rise in blood copper of the control group during the winter period when they were kept in stalls. This elevation can be correlated with cessation of grazing and an increase in the amount of "foreign" foodstuffs, *i.e.*, not grown on the farm. To get more information on this point an extra allowance of "foreign" concentrates at the rate of 4 lb. per head per gallon of milk over the first 2 gallons was given to the control group of cows during the next winter. The result of this treatment was elevation of blood copper values to approximately normal levels and a marked improvement in clinical condition. The extra allowance of "foreign" foodstuffs was stopped when the cows were put out to grass in the spring. Blood copper levels gradually fell during the following months until in the autumn the initial low levels were reached. Intermittent scouring returned but the clinical condition remained satisfactory.

It is of interest that blood copper values of calves on this farm remained normal for about the first nine months after which there was a steady decline with increase in age. This decrease could be correlated to increased grazing and decrease of "foreign" food in the form of calf meals and nuts, etc. It is noteworthy that the calves on this farm did not thrive well, were stunted and were susceptible to heavy lung-worm infestations.

The results of these limited observations indicate that although the copper content of the pastures was normal, a low copper status of the adult animals on this farm was a factor in the disease syndrome described and that administration of copper produced a marked improvement in the condition. The fact that the group of animals receiving the complex mineral mixture did not improve more rapidly than the group receiving copper only indicates that a lack of other trace elements was not a contributory cause.

Since these first observations on "conditioned" copper deficiency in dairy cows in Shropshire, hypocupraemic disorders of cattle have been observed in various parts of the country and their incidence and distribution are at present under investigation. Because of the possible economic importance of a subnormal copper status in cattle, a blood copper survey of selected herds throughout the country is being carried out by the Veterinary Laboratory at Weybridge in conjunction with Veterinary Investigation Officers in England, Wales and Scotland.

During the last year well over 100 herds have been investigated in England and Wales and of these one-third were found to have a low copper status associated with a variety of clinical conditions. An idea of the distribution so far observed is given in Fig. 2 (*over-leaf*).

In Scotland, the County of Caithness was subjected to much more intensive investigations because of the occurrence there of a copper deficiency syndrome which appeared to differ from those observed in other parts of the country at the time of investigation but which has since been found in several other areas in England as well as in Scotland. Of 123 herds surveyed in Caithness 65 per cent. were found to have hypocupraemic disorders. Results of preliminary investigations into "copper pine in calves in Caithness" have been published (Jamieson & Allcroft, 1950) but since

FIG. 2.—Map showing distribution of farms in England, Wales and Scotland where hypocuprosis in cattle has already been found.

the journal is not readily available to veterinarians it may be of interest to give a brief description of the observations.

In Caithness it is the calves which are affected much more than the cows. The cattle are a beef breed and the condition occurs mainly in Aberdeen-Angus crossbred and in crossbred-Highland calves. Cattle are housed in the winter, calves are born during April and May and are then pastured with their mothers until the calves are sold in autumn.

The first symptoms usually appear about a month after turning out to grass. The calves show a stilted gait, progressive signs of malnutrition follow and the coat becomes rough, dull and discoloured. In some cases there is a definite change of colour of the black hair around the eyes to grey so that calves have a definite " spectacled " appearance. Diarrhoea is not a constant feature and anaemia has not been found. Unthriftiness becomes more marked as the animals continue on pasture and after about four months the appearance is similar to that shown in Fig. 3. In some seasons the condition develops more rapidly than in others and death may occur at about four or five months of age. Affected animals which survive improve under winter conditions of management but can be recognised easily the following year as development is subnormal. The clinical condition, however, does not recur when they are on pasture during their second year. The incidence of clinical cases is usually in the region

FIG. 3.—Six-month-old " pining " Aberdeen-Angus crossbred calf showing depigmentation of the hair around the eyes. Live weight 336 lb. Dead weight 189 lb.

of 20 to 25 per cent. of the calf population grazing affected areas but varies on different pastures. In some instances practically all the calves become obviously affected.

Four farms were selected for preliminary experimental observations because of the high incidence of pining in calves. Blood copper values for cows and calves on all four farms were low, averaging 0·3 mg. per litre. Pasture samples showed copper values ranging from 4·8 to 20·8 p.p.m. on a dry matter basis. Apart from the one low figure of 4·8 p.p.m. on a sample of herbage from very rough grazing, all the other values fall within the usual normal range reported by Eden (1944) for parts of England and Wales. Molybdenum values varied from 1·1 to 19·5 p.p.m. dry matter on samples from different fields on the four farms. It should be pointed out that the quality of pastures on most farms in Caithness is good and there is no question of the pining condition being associated with lack of food.

The effect of copper sulphate treatment was observed in animals on two farms in which the incidence of pining was high. On farm A a small dose was given once only to two groups of three three-month-old calves of crossbred Aberdeen-Angus breed. One group received the equivalent of 50 mg. copper intravenously, the other of 500 mg. of copper by mouth. A similar group of untreated calves served as controls. On farm B four calves and their mothers were each given 5 grammes of copper sulphate orally (equivalent to 1,250 mg. of copper) at monthly intervals for three months while a similar untreated group on the same pasture served as controls.

In both experiments blood samples were taken before treatment and subsequently at monthly intervals. At the end of four months when the calves were six to seven months old, two untreated control calves and one treated calf from each farm were weighed and killed for *post-mortem* examination and estimation of copper in selected tissues.

The results from farm A showed that when only one small dose of copper was given, either orally or intravenously, copper values for blood and tissues were not raised to normal levels, but that clinical symptoms of pine were nevertheless prevented and apparently normal development ensued. Fig. 4 shows a calf of similar age and breed to that in Fig. 3. Both were kept under identical conditions on the same pasture, the only difference being

that the calf in Fig. 4 received 50 mg. copper intravenously when three months old. In spite of the administration of copper which prevented symptoms of pine and resulted in a marked increase in live weight, all blood copper values throughout the experimental period remained low.

Fig. 4.—A calf of the same age and breed grazing the same pasture as the calf in Fig. 3, four months after receiving one intravenous injection of 50 mg. copper. Live weight 448 lb. Dead weight 264 lb.

On farm B, where larger supplements of copper were given at monthly intervals, blood copper values in both calves and cows increased throughout the experimental period. Mean values for the calves increased from 0·5 to 0·7 mg. per litre and those for the cows from 0·3 to 0·7 mg. per litre. Values for the untreated controls fell in a similar manner to those on farm A. The higher copper supplement increased liver copper storage and resulted in increased growth as shown by live weight increases of over 1 cwt. between treated and untreated calves. Although the exceedingly small dose of copper given on farm A actually prevented pining for the short period concerned, subsequent observations showed that doses of copper large enough to maintain normal values in blood and liver gave better growth and development rates.

To get more information on optimum dosage levels of copper, and to find the most economical way of supplying adequate amounts of this essential trace element to beef cattle under existing methods of husbandry, various treatments were tried out during 1949.

On some farms mineralised cubes supplying copper at the rate of 0·3 g. per day were fed to the cows during the last five months of the gestation period. Observations were made on groups of calves from treated and untreated mothers and in some groups extra copper was also supplied to the calves. On other farms no copper supplements were given to the pregnant cows or to the calves but the pastures were top-dressed with copper sulphate during March at the rate of 10 lb. per acre and subsequently grazed by the cows and calves from May until October.

The results of these experiments (Jamieson & Allcroft, 1951) indicated that the best live weight gains were made by calves which received copper supplements at monthly intervals throughout the grazing season and whose mothers had received copper during the last five months of pregnancy. No symptoms of pining, however, occurred in the group of calves which did not receive extra copper after birth and whose mothers had had copper supplements, but weight gains of this group were not as good and blood copper levels were below normal at the end of the experimental period. On the farm where the pastures were top-dressed with copper sulphate, no symptoms of pining occurred, the calves were in good condition and blood copper levels were within the normal range.

Copper figures obtained from monthly pasture samples of the top-dressed fields indicated that the grass was still heavily contaminated with copper sulphate when the cattle grazed these fields during May and June, 1949. In the autumn the copper content had fallen to levels found before top-dressing. Observations made during the next grazing season showed that pining again occurred on pastures which were top-dressed the previous year. Therefore, not only would the pastures have to be top-dressed annually but the application would have to be made shortly before the animals were turned out and the effectiveness would probably depend on the rainfall and degree of contamination during the first few months of grazing.

It should also be mentioned that it may be unwise to attempt to control these disorders in cattle by top-dressing pastures of normal copper content with copper sulphate on farms where sheep are kept, since it is known that under certain circumstances, not yet fully defined, sheep can store excessive quantities of copper in the liver even when grazing pastures of normal copper content. This excessive storage of copper sometimes leads to death due to copper poisoning. This condition is well known in certain parts of Australia and New Zealand where it is termed " enzootic " or " toxaemic jaundice " but has not so far been found in Britain although deaths do sometimes occur here from copper poisoning in sheep grazing orchards in which copper insecticidal sprays have been used.

Copper-Molybdenum Relationships

Before discussing this aspect it would be best to give a brief outline of molybdenosis or " teart " which is the local name for a scouring disease of cattle occurring in central Somerset, and in small areas of Gloucester and Warwick, associated with the molybdeniferous lower lias geological formation of those districts.

Although the association of " teart " pastures with severe diarrhoea and unthriftiness of cattle in Somerset had been recognised for many years, it was not until about 10 years ago that Ferguson, Lewis and Watson (1943) showed that the disorder was due to a high molybdenum content of the pastures. They found figures up to 100 p.p.m. on dry matter and figures well above 20 p.p.m. are common for that area. British pastures may be regarded as containing a common normal of about 1 to 3 p.p.m. Mo expressed on the dry matter but values of 3 to 10 p.p.m. are found in non-teart areas, *i.e.*, areas not associated with a lower lias geological formation, and occasional values as high as 20 p.p.m. have also been observed.

The disorder mainly affects cows in milk and young stock. Diarrhoea may commence even within 24 hours of putting cattle on to affected pastures in spring, and the dung soon becomes watery, evil-smelling and yellow-green in colour. The animals become filthy, develop staring, discoloured coats and lose condition rapidly, eventually suffering permanent injury or death. The rapidity with which recovery takes place on transfer to non-teart pastures is very characteristic. The severity of scouring is directly

related to the water-soluble molybdenum in the grass, which is highest during the active phase of growth and lowest in old grass. The disease is a straight-forward molybdenosis and can be produced in a few days in stalled animals by dosing with sodium molybdate, or by putting cattle on to any growing pasture dressed with molybdate in amount sufficient to bring the molybdenum content up to " teart " levels. The mechanism of the scouring effect is not yet understood but it is thought to concern only the alimentary tract, and the diarrhoea can be controlled by the therapeutic use of copper sulphate. A daily dose of 1 g. for young stock and 2 g. for cows, administered most conveniently as ½ lb. or 1 lb. of " anti-teart " cake (copperised dairy cubes) is sufficient to maintain animals in good health throughout the " teart " season. This copper supplement has little or no effect on the absorption of molybdenum and levels of this element in the blood and urine of the cattle remain high without apparent adverse effect.

Since depigmentation of hair had been reported in Holland in cattle suffering from scouring diseases attributed to copper deficiency, and change of coat colour, but not true depigmentation, is associated with scouring in the " teart " areas of Somerset, and since both disorders could be prevented and cured by administration of copper sulphate, Russell, in her review in 1944, suggested that this might be taken as presumptive evidence of copper deficiency in " teart " cattle. She suggested that an abnormal intake of molybdenum interfered with the utilisation of copper and reviewed the literature on " teart " in the light of " conditioned copper deficiency." The Australian work of Dick and Bull (1945) recorded observations indicating that high molybdenum intake in a diet reduced the storage of copper in the livers of cattle and sheep and brought copper-molybdenum relationships into prominence, and Cunningham in New Zealand (1946) suggested that " peat scours " of cattle may be the result of a small excess of molybdenum in the pastures superimposed on a moderate deficiency of copper. Later Cunningham (1949) confirmed the observations of Dick and Bull and showed that a high intake of molybdenum over a prolonged period did reduce liver copper storage and also blood copper levels in bovines.

In the section on sheep it was pointed out that investigations at Weybridge have not so far confirmed the view that " conditioned " copper deficiency *in sheep* is related to a high molybdenum intake. Observations on *cattle*, however, indicate that liver copper storage *can* be reduced by a high molybdenum intake over a long period, thus confirming the observations of the Australian and New Zealand workers.

It was found that administration of 800 mg. of molybdenum daily to five Guernsey heifers over a period of about 18 months reduced average liver copper values from about 100 p.p.m. Cu on a dry matter basis to about 20 p.p.m. Blood copper values, however, remained within normal limits for about 15 months after which there was a definite decrease associated with a marked falling off in clinical condition. The amount of molybdenum given throughout this period was not sufficient to cause scouring and, therefore, the loss of condition could not be attributed to this.

More recent observations have shown that 400 mg. of molybdenum given three times a week will significantly reduce liver copper storage in young cattle 12 to 20 months of age both under grazing and stalled conditions and will prevent increased storage of liver copper in copper deficient calves. It is of interest, however, that under stalled conditions, although low liver copper values can be produced and maintained (decreases from approximately 150 to 15 p.p.m. on a dry matter basis have been found, using liver biopsy samples for checking storage of copper) no loss of weight or other clinical conditions associated with copper deficiency have occurred. This is well illustrated in Figs. 5 and 6, which show two Guernsey heifers of similar age which received a high molybdenum intake (800 mg. Mo daily) over a period of 18 months, the only difference being that the heifer shown in Fig. 5 was on pasture with an average Cu content of 11 p.p.m., while that in Fig. 6 was kept indoors on hay, oats and straw supplying about 8 p.p.m. Cu. The fact that copper storage in deficient animals can occur very rapidly under stalled conditions, when fed hay and oats supplying less copper than pasture, was reported by Allcroft and Parker (1949). This remarkable differ-

FIG. 5.—A two-and-a-half-year-old Guernsey heifer showing clinical symptoms of hypocuprosis after being on a high molybdenum intake over a period of 18 months while at grass.

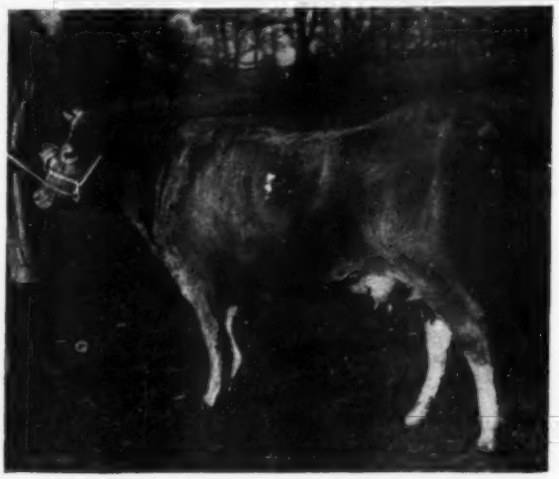

FIG. 6.—A Guernsey heifer of similar age and on a similar high molybdenum intake over the same period as that shown in Fig. 5 but kept inside under stall conditions. Although her liver copper status was reduced to the same low level as the molybdenum-dosed heifers at grass, her clinical conditions remained normal.

ence in clinical condition between copper deficient stalled and grazing animals and the rapid storage of copper when green foods are not fed, requires much more investigation but it may well be a clue to the "conditioning" effect of some pastures that produce a deficiency of copper in ruminants grazing them even though the copper content of the herbage is adequate.

Since no observations on the copper status of animals in the "teart" area of Somerset were reported by Ferguson, Lewis and Watson, a series of investigations was started at Weybridge in 1947. Blood samples obtained from cattle which had not had prophylactic copper supplements on "teart" farms were generally found to show low copper values. In 1948, six normal heifers sent from Weybridge to a "teart" farm with pasture molybdenum ranging from 16 to 40 p.p.m. commenced scouring in one or two weeks and were left to scour continuously for a further four weeks, during which time no consistent change in blood copper occurred despite elevation of blood molybdenum. At this point scouring was controlled in four of them by intravenous or oral administration of copper sulphate. The remaining two served as controls and continued scouring for a further six weeks until the pastures became "non-teart" after frosts. An appreciable fall in blood copper ensued in these two. Observations on these six heifers were continued over a further three "teart" seasons and over a total period of about 20 months. During this time four of them had 300 mg. Cu intravenously on two occasions while the two controls were left untreated. There was a marked difference in the clinical condition between treated and untreated animals. The controls showed the usual unthrifty appearance of "teart" animals and their blood copper values remained between 0·3 and 0·5 mg. per litre for about 15 months. Blood copper values of the injected animals averaged 0·75 mg. per litre over the same period and their clinical condition was much better than that of the two controls although insufficient copper had been given to maintain them in first-class condition.

Experiments on stalled cattle at Weybridge in 1948 showed that daily administration of a few grammes (2·3 to 6·9) of sodium molybdate produced scouring even on winter rations in 16 to 24 days but some animals were more resistant and did not scour even after six weeks, although there was a marked loss of condition. Depression of blood copper did not occur over this period despite enormous elevation of blood molybdenum (40 to 200 times). Heifers placed on Weybridge pasture with a copper content of 11 p.p.m. D.M. dressed with molybdate to elevate it to 40 to 60 p.p.m. Mo D.M., scoured severely in five days without significant change in blood copper level but with greatly raised Mo level. Intravenous injection of 500 mg. molybdenum as sodium molybdate on three successive days failed to produce scouring or alteration of blood copper in two cows. No liver biopsy samples were taken during these observations to check the effect on liver copper storage, but recent experiments on three heifers placed on the molybdenised Weybridge pasture indicated that there was an appreciable fall in liver copper values with onset of scouring in 11 days although there was no fall in blood copper. These preliminary observations require confirmation and, doubtless, some ingenuity in interpretation.

The scouring of molybdenosis has been regarded generally as primarily due to disturbance within the alimentary tract and not to molybdenum circulating in the blood stream. The mode of action of excess molybdenum in bovines is under investigation as well as the function of copper, administered *per os* or intravenously, in controlling diarrhoea.

These observations indicate that a high molybdenum intake in cattle can reduce liver copper storage and that cattle on the "teart" farms investigated have a low copper status, but "hypocupraemic scours" has also been observed in Somerset outside the actual "teart" area both on low lying peat land and on good loam soil near Chewton Mendip. Fig. 7 illustrates this distribution. On the low-lying peat areas pasture molybdenum values ranged from 3 to 12 p.p.m. with an average of about 8 p.p.m. On the Chewton Mendip farm pasture Mo figures were 1 to 2 p.p.m. Pasture copper on all farms investigated was normal or even high.

SOMERSET
CHEWTON MENDIP
R. BRUE
GLASTONBURY
SHEPTON MALLET
TAUNTON
PASTURES OF HIGH Mo CONTENT (20 - 80 p.p.m)
PASTURES OF MODERATELY HIGH Mo CONTENT (5 - 15 p.p.m)
PASTURES OF NORMAL Mo CONTENT (<1 - 2 p.p.m)

Fig. 7.—An outline map of the county of Somerset showing areas with high, moderately high and normal molybdenum content of pastures where hypocuprosis in cattle has been found.

It was observed that pining in calves in Caithness occurred as rapidly and severely on pastures having a molybdenum content of 3 to 7 p.p.m. as on those with a molybdenum content of about 20 p.p.m. Subsequent investigations (Jamieson & Allcroft, 1951) indicated that even when calves on a "pining" farm were dosed with molybdenum throughout the grazing season, liver copper storage was not appreciably lower than in untreated controls nor was loss of condition more severe.

The results obtained so far of our investigations into copper-molybdenum relationships may be summarised as follows:—

1. *In Sheep.* The molybdenum content of pastures in Britain appears to be unrelated to incidence of swayback.

2. A high molybdenum intake over a long period not only failed to maintain the low copper status of a small number of stalled sheep but permitted rise of both blood and liver values to normal.

3. *In Bovines.* A prolonged high molybdenum intake does reduce liver copper storage and blood copper levels.

4. Cattle in the " teart " areas of Somerset, where pasture molybdenum values are high and copper values are normal, show a hypocuprosis.

5. Cattle outside the " teart " area in Somerset, however, on pastures of normal and moderately high molybdenum content, have also been found to have low blood and liver copper values and to show clinical conditions associated with hypocuprosis.

6. Calves in Caithness pine as rapidly and severely on pastures of 3 to 7 p.p.m. Mo as on pastures of 20 p.p.m. and administration of additional molybdenum does not increase the loss of condition on " affected " farms.

7. The evidence indicates, therefore, that a high molybdenum content of the pastures is not the only factor which interferes with the utilisation of copper in ruminants.

It is difficult at this stage to offer an adequate explanation for the conflicting effect of a high molybdenum intake associated with normal dietary copper, on liver copper storage in bovines and sheep, but for the moment two factors may be predicated: (a) molybdenum, which may function as a regulating factor in liver copper storage, and (b) another even more powerful unknown factor which is the operative one in " swayback " areas, where molybdenum content of pastures is normal, and in Caithness and other areas where " copper pine " of calves is apparently independent of molybdenum intake.

It is also interesting to speculate on the reasons for the striking clinical and pathological differences resulting from copper deficiency in cattle and sheep. Why should a low copper status be associated with cachexia in the cow without demyelination in the calf, yet leave the adult ewe apparently healthy while affecting the lamb *in utero* so profoundly?

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Members of the Harrogate Chamber of Trade discussed a proposal that customers' dogs should be banned from food shops, but they disapproved of the proposed ban by 17 votes to 9. They agreed, however, to recommend the display of notices requesting customers to keep their dogs on short leads.

THE VETERINARY RECORD

January 12, 1952

A FACULTY OF VETERINARY SCIENCE

THE recent announcement that the Court of the University of Liverpool has approved the raising of the status of its Board of Veterinary Studies to that of a Faculty will give pride and pleasure, not only to the graduates of that school, but to the profession generally. We understand that before this can be put into full effect the formal approval of the Privy Council to the necessary modification of the Statutes of the University will be required.

It is fitting that the school, which first became an integral part of a British University some 50 years ago, should also be the first to achieve the distinction of becoming a Faculty.

In its second report, the Loveday Committee favoured the idea that veterinary education should be undertaken in a separate Faculty of Veterinary Medicine in a University, rather than as a function of an existing Faculty; but, in relation to the creation of a new Faculty within it, a University has much to consider. Has veterinary science attained that stage of development which merits the award of a status the same as that of the other learnings? Does the school possess the membership adequate in number and in quality to ensure that the Faculty is administered with vigour and efficiency, and that teaching and research are prosecuted at a level which will uphold the best traditions of the University? The University of Liverpool has approved the establishment of a Faculty of Veterinary Science and thereby shows that it regards its veterinary school as capable of discharging these duties and responsibilities, and of taking its place alongside the Faculties of Arts, Science, Medicine, Law and Engineering.

The veterinary school has hitherto been part of the Faculty of Medicine and has received assistance from the Faculty of Science. It has accepted help and encouragement from these Faculties during its formative years and its students have benefited by sitting alongside those studying medicine, science and dental surgery. Within recent years the Liverpool Veterinary School has been given a very large measure of autonomy in the conduct of its affairs, and we understand that co-operation between the Veterinary Faculty and the Faculties of Science and Medicine will continue.

A University is a community of men and women engaged in study and research and the influence it has on those working in it extends far beyond the narrow confines of any particular discipline. Living, studying and playing within a community of men and women of a wide variety of interest and learning is an experience extending far beyond the limits of examination and professional achievement. Those future members of our profession destined to enjoy these facilities will gain much and increase their usefulness to the community they serve. Members of the new Faculty will be proud of their place in the University and will, we are sure, continue in their efforts to enhance the standards of its scholastic quality.

PRELIMINARY OBSERVATIONS ON THE SUBSURFACE CULTIVATION OF *MYCOBACTERIUM JOHNEI*, AND THE PREPARATION OF JOHNIN FROM SUCH CULTURES

BY

H. R. ALLEN, M.R.C.V.S.,

Department of Medicine, Royal Veterinary College

In view of the fact that the tubercle bacillus has been successfully cultivated by subsurface methods, in synthetic media, it was decided to investigate the possibilities of growing *M. johnei* on similar lines. This has been achieved, and a "johnin" has been prepared from such cultures.

The medium which has been employed for this purpose is as follows :—

Asparagine	0·5	per cent.
Potassium phosphate ($K HPO_4$)	0·5	"
Magnesium citrate	0·25	"
Glycerine	2	"
Distilled water to	100	"

The method of procedure was as follows :—

A few milligrammes of a young, actively growing culture of *M. johnei*, on egg medium, was thoroughly ground up in a small amount of medium—under sterile conditions—and then distributed into the depth of a series of flasks containing the same medium. The flasks were incubated at 39° C. The resultant growth, though slow at first, proceeded satisfactorily and at the end of six weeks was quite marked.

At this stage the contents of the flasks were concentrated to one-tenth the original volume, filtered through a Berkfeld N. candle and preserved with merthiolate (1 : 10,000).

Following this, the activity of the product as a diagnostic agent was determined.

A herd of 31 Jersey cows, in which Johne's disease had been diagnosed clinically and confirmed by faecal examinations, was placed at our disposal. The double intradermal test was carried out, the results of which are appended.

The amount of johnin injected was 0·1 c.c. for each of the two doses given.

It will be observed that in the cases of the cows Nos. 1, 2, 3, 4, 11 and 30—Nos. 1 and 2 were negative to faecal examinations—whilst Nos. 3, 4, 11 and 30 were positive. The intradermal tests carried out on these same six cows were in complete agreement with the faecal findings.

In view of the encouraging results obtained it would appear that further research into the questions under consideration is justified. This is now being carried out, using modifications of the medium described, for the purpose of ascertaining the most suitable medium for general use in the cultivation of *M. johnei* by subsurface methods as the adaptability of different strains varies very markedly.

I wish to express my thanks to my colleague, Mr. E. F. Lewis, M.R.C.V.S., who kindly carried out the intradermal tests and the faecal examinations on my behalf.

Double Intradermal Test (Subsurface "Johnin") and Faecal Examinations

Animal number	Skin measurements: Normal skin	48 hours	72 hours	Result	Faeces
	mm.	mm.	mm.		
1	8	10	10	—	—
2	6	8	8	—	—
3	8	15	19 D, O	+	+
4	8	11	12 D, O	+	+
5	8	8	10 S, D	Doubtful	Not done
6	10	11	12	—	"
7	8	8	10	—	"
8	10	14	15 D, O	+	"
9	7	11	12 D, O	+	"
10	6	7	10 D, O	+	"
11	8	14	20 D, O	+	+
12	7	9	12 D, O	+	Not done
13	6	20	24 D, O	+	—
14	7	8	8	—	Not done
15	8	8	8	—	"
16	8	8	9	—	"
17	9	9	9	—	"
18	7	8	8	—	"
19	6	6	10 SD, O	+	"
20	6	9	10 SD, O	+	"
21	7	10	10 SD	Doubtful	"
22	6	14	18 D, O	+	"
23	7	7	9	—	"
24	6	12	14 D, O	+	"
25	10	14	16 D, O	+	"
26	8	8	9	—	"
27	7	9	10 SD	Doubtful	"
28	7	8	8	—	"
29	8	8	12 D, O	+	"
30	7	11	13 D, O	+	+
31	6	10	11 D, O	+	Not done

D = Diffusion SD = Slight diffusion O = Oedema

SOIL CONDITIONING AT SPEED

U.S. Scientists' Claim

"A synthetic substance which is claimed to be capable of converting non-productive into productive soil in a matter of hours was demonstrated recently at the annual meeting in Philadelphia of the American Association for the Advancement of Science," reports the New York Correspondent of *The Times* in its issue of December 31st. "The chemical, a powder called krilium, is not a fertiliser but a soil-conditioner, a synthetic substitute for natural humus components. It enables plants to obtain optimum amounts of oxygen and water and of the nutrients that are in soil. The demonstrators said that its primary effect was to form and to stabilise natural soil aggregates against the dispersing and slaking action of water.

"Krilium has been extensively tested during the last three years by the Monsanto Chemical Company, which developed it, and by about 80 soil scientists in various parts of the United States. A report by William L. Laurence, a scientific correspondent of the *New York Times*, said that the tests indicated 'the beginning of a revolutionary era in agriculture in which man-made deserts may be turned in a short time into blooming gardens and green acres.' Dr. C. A. Hochwalt, director of research for Monsanto, said that krilium is in chemical language 'a poly-electrolyte.' It carries scores of negative electrical charges which seem to react with the positive charges in the soil's minerals to give soil its proper structure.

"The new chemical will not be sold in quantity until 1953, but a $50,000,000 plant is being constructed by the company in Texas to produce acrylonitrile, the primary material for krilium, as well as for a number of other plastic substances. In the early stages of production krilium will be sold for something less than $2 lb. One pound of it is said to have the same effect on soil structure as 200 lb. of peat moss."

* * * * *

Weekly Wisdom

By "the mass mind" he supposed was meant the unreflective mind which passively received impressions second-hand. The only adequate protection against that was a technique of criticism and an unwillingness to accept what was offered, which could be achieved only by a hard process of education and self-education. The universities would have to help by making sure that students, in addition to having special training in their chosen fields, were able to tidy up their own minds on the subjects which were confusing the public mind.—Mr. J. S. Fulton, Principal of the University College of Swansea, addressing the Conference of Educational Associations, at King's College (January 2nd, 1952).

CLINICAL COMMUNICATION

STRICTURE OF THE OESOPHAGUS IN THE DOG

LEONARD R. GEFFEN,
Liguanea, Jamaica, B.W.I.

The following two cases, occurring almost simultaneously in a small community, may prove of interest to readers.

Case 1

Subject.—Poodle puppy (female), born 28.5.51. Brought for treatment 1.8.51.

History.—By far the smallest and lightest in the litter. Had been perfectly well while on the breast, but since weaning had been unable to retain any solid food : food was being returned undigested almost immediately after ingestion.

A tentative diagnosis of ? foreign body was made and an X-ray photograph requested. The photographs were taken the following day but showed no opaque foreign body. The radiographer stated that the shadows in the lower intestine were suspicious of an intussusception. The dog was given a slow high enema with a view to straightening this out. Treatment later the same day took the form of a subcutaneous injection of glucose saline to combat dehydration. The following day the dog appeared brighter and was able to keep down small amounts of liquid. Another enema was given and the dog was again radiographed. There were now no shadows in the lower intestine, but neither was there a foreign body.

6.8.51. Dog again brought for treatment. It was now much weaker and unable to keep down even liquids. A further radiograph was taken and once again proved to be negative.

7.8.51. The dog was examined and an immediate exploratory laparotomy was suggested. Despite the fact that the dog was daily becoming weaker the owner demurred, and the following day telephoned that it was slightly better and that he thought it might recover with nursing. He did not wish for an operation and would communicate when he thought the animal would benefit from a further consultation.

One week later, the owner called with the dog. It was now in a state of complete collapse and extreme emaciation ; there was evidence of pleurisy and hypostatic pneumonia. The owner requested me to destroy the dog and to perform a *post-mortem* examination.

Post-mortem *Findings.*—The abdomen was normal except for a hookworm infestation of both the small and the large intestine. The thorax showed lesions indicating pleurisy and pneumonia. A stricture of the oesophagus, measuring $\frac{3}{4}$ inch in length, and causing an almost complete occlusion, was present behind the third and fourth ribs. There was a diverticulum of the oesophagus in front of the stricture and this stretched forward for a distance of 3 inches.

It is the writer's opinion that the stricture was congenital and became obvious only when the puppy was given solid food. It is interesting to note that at the time of writing (10.10.51) all the other puppies in the litter are well and normal.

Case 2

Subject.—Cross-bred Bull-Mastiff-Alsatian-Great Dane, aged 16 months. First seen 15.8.51.

History.—This dog had been quite normal until it had distemper at the age of three and a half months, since when it had had difficulty in keeping down solid food but could retain soft foods and liquids. The dog was well grown but lean and cachectic.

The owner, a doctor, suggested that the cause might be a stricture of the pylorus, similar to that occasionally seen in first-born male human children.

The owner followed the writer's suggestion that a series of radiographs should be taken at 30-minute intervals after the giving of a barium meal, and on the afternoon of 17.8.51 the photographs were brought. These showed a diverticulum on the oesophagus about the size of a duck's egg, commencing just in front of the first rib and extending behind the second. Immediately behind the diverticulum was a small constriction.

The owner was advised as to the seriousness of the condition and that it could be cured only by operative interference. He was further advised that the operation would be attended by considerable risk. He decided to continue feeding the dog on liquids for a few days and to communicate his decision later.

On the evening of 17.8.51 there arrived the now famous Jamaica hurricane. The owner had a house up in the hills about six miles away, and owing to fallen trees and washed-away roads he was marooned for nearly a week. At the end of this time he called (he had been unable to telephone as all the lines were down) and informed me that the dog was pneumonic and very weak. He asked me to destroy the dog, and this was done on the following day.

Post-mortem *Findings.*—These were in complete agreement with the diagnosis made from the X-ray photographs and with the pneumonic symptoms observed.

It would be interesting to know if this, also, was a congenital condition, as the writer believes, or if the owner could have been right when he suggested an aftermath of distemper.

REPORT

[R.S.P.C.A.—Cairo : Annual Report for 1950.]

One of the greatest difficulties encountered during the year was the high cost (nearly doubled) and scarcity of forage. In fact it was obtainable only on the black market. Private owners faced the same situation. Consequently, the greatest number of animals seized by the police and admitted to the Society's infirmary were suffering from extreme debility owing to lack of food. The Committee was obliged to substitute barley by husks of beans and lentils mixed with bran, as an exceptional measure, until at last the Government decided to import barley from abroad. But this assistance did not come in time to prevent much suffering.

The number of animals admitted was 4,385 as compared with 4,713 in the previous year, a decrease due to the death of the Society's inspector.

The Society's financial situation has remained satisfactory although it has been difficult for the Committee to maintain a balanced budget and to meet ever-increasing expenses. Receipts from subscriptions and donations decreased by £E.250, and out of the total received of £E.4,697, no less than £E.1,060 of it was expended on forage. The Society paid £E.620 to owners as compensation for animals destroyed.

H. K.

REVIEW

[**Hen Batteries.** W. P. Blount, T.D., PH.D., F.R.C.V.S. Pp. viii + 258 (69 figs.). Bailli re, Tindall & Cox, 7 & 8, Henrietta Street, London, W.C.2. Price 15s. net.]

This is a most comprehensive book and deals with all aspects of this important branch of the poultry industry. It is essentially practical and, as a result of the author's experience, he is able to offer much valuable and helpful advice.

Under modern conditions the aim of the commercial egg-producer is to develop methods of maximum production allied to minimum labour costs and, to meet these needs, the hen yard, the battery and the deep litter systems are most favoured. The author considers that since the emphasis is on winter egg production the battery is superior. There is not much to choose between it and deep litter from the point of egg production only, but other beneficial aspects are stressed ; the very much heavier capital outlay is the chief drawback.

The development of the laying battery is traced from its simple beginnings to its present advanced state of highly efficient mechanisation and an extensive list of plants supplied by the chief makers is included. There is a full description of each battery ; the author indicates the best features, innovations and labour-saving devices and points out any disabilities or less desirable factors.

The type of bird likely to do well in the battery is discussed and from extensive trials the author concludes that heavy breeds are to be preferred, with the Rhode Island Red outstanding. Light-heavy cross pullets are also recommended. In his view it may be more profitable to dispose of birds after a season's laying ; the various methods of providing replacement stock are considered.

Problems of housing, ventilation, heating and lighting are dealt with adequately and in an interesting chapter on " Food and Feeding " the controversial question " Mash or Pellets ? " is discussed. As far as egg production only is concerned, when feeding is *ad lib.* it matters little, but pellets are favoured as being cleaner, easier to handle and less wasteful. For restricted feeding the author considers pellets to be unquestionably superior.

A section of the book is devoted to diseases and vices peculiar to this system of husbandry and an analysis of *post-mortem* records during the hen-battery trials from 1947 to 1949 is included. The author points out that apart from an odd outbreak of laryngotracheitis and Newcastle disease, the only epidemic disease recorded in batteries in this country is infectious coryza and most workers will be in agreement. A marked increase in the incidence of nephritis and visceral gout during recent years is recorded. The other diseases described are those common to all systems of poultry management.

There is a valuable chapter on costings and helpful advice is given on points of practical importance to prospective beginners.

There are short accounts of the battery system in the U.S.A. and its application to ducks and the book concludes with a stated case on the vexed question, regularly raised in the Press, "Are hen batteries cruel ? " The author rightly points out that there is no evidence to suggest that there is any more cruelty in a well-run battery than in any other satisfactory system of poultry husbandry.

The subject matter is amplified by illustrations, tables and graphs ; the book is well printed and easy to read. It should prove useful to anyone seeking information on the subject.

ABSTRACTS

Serum Levels of Aureomycin in Foals*

Using a modification of the assay technique of Dornbush and Pelcak, the authors determined the sensitivity of a number of equine pathogens to aureomycin and ascertained the dosage required to maintain a bacteriostatic serum level in foals of 240 to 420 lb. weight in excess of that required for *in vitro* inhibition. They tabulated the sensitivity of the organisms tested as follows :—

	No. of cultures	Microgrammes of aureomycin causing complete inhibition of growth		
		Incubation time		
		4 hours	8 hours	24 hours
Streptococci*	15	<0·012–12·5	0·39–25	>25
Streptococcus equi	1	6·25	>25	>25
Pseudomonas aeruginosa	10	6·25–>25	6·25–>25	>25
Shigella equali	6	<0·012	0·012–0·098	0·195–0·39
Corynebacterium equi	1	<0·012	0·098	0·39

* Lancefield group C, Ogura type A

An average serum level greater than the amount of aureomycin required for *in vitro* inhibition of *Shig. equali* and *C. equi* was present for 20 hours following a single intravenous injection of 10 mg. per lb. bodyweight and for eight hours following a dose of 5 mg. per lb. A bacteriostatic concentration for the more sensitive strains of *Shig. equali* persisted for 20 to 24 hours following a dose of 10 mg. per lb. and for 16 to 20 hours after a dose of 5 mg. per lb. Serial doses of 5 mg. per lb. bodyweight at 12-hour intervals maintained serum levels in excess of that required for the *in vitro* inhibition of *Shig. equali* and *C. equi.* Adequate therapeutic serum levels for *Strept. equi* and *Pseudomonas aeruginosa* were not attained by doses of 5 mg. per lb. and were maintained for but four hours after a dose of 10 mg. per lb.

The authors consider that infection caused by *Shig. equali* might be expected to yield to aureomycin therapy. In their hands a number of such cases responded satisfactorily. Response in *C. equi* infections may be poor because of its proclivity for massive abscess formation. Because of the absence of a definite relationship between the apparent *in vitro* and the actual *in vivo* bacteriostatic levels the authors do not preclude the possibility that this antibiotic may be used with success against strangles and infection due to *Pseudomonas aeruginosa.*

G. J. K.

*Serum Levels of Aureomycin in Foals. McCollum, W. H., & Doll, E. R. (1951.) *Vet. Med.* **46.** 84-86.

* * * * *

Poisoning of Calves by Benzene Hexachloride*

A batch of seven six-month-old calves were accidentally fed approximately four tablespoonfuls of Lindane (99 per cent. gamma isomer of BHC). The insecticide was given at 8 a.m., and by 8.45 a.m. symptoms of poisoning were evident. The calves had collapsed, were trembling, and were struggling violently with their heads arched backwards. There was, also, marked salivation and grinding of the teeth. All these

*Accidental Poisoning of Dairy Calves by Benzene Hexachloride. McEnerey, P. J. (1951.) *Cornell Vet.* **4.** 292-295.

XUM

calves were dead by 1 p.m., five hours after receiving the Lindane.

A second group of three calves, one month old, were given milk from the same pail as that used to feed the seven-month calves. One of this group, some hours later, was found to be trembling, and circling backwards ; it collapsed, but after struggling violently it was able to rise again ; it recovered, the symptoms passing off within 10 minutes.

The bodies of the seven calves which died were examined *post mortem*. Macroscopic lesions were confined to ecchymoses of the oesophagus, trachea, pericardium and endocardium. Microscopic examination revealed some gastric and renal congestion.

D. W. J.

* * * * *

Cerebellar Disorders in Lambs*

Following a brief account of the normal histology of the ovine cerebellum, the authors compare the neuro-pathological picture found in cases of daft lambs (Innes, Rowlands & Parry (1949.) *Vet. Rec.* **61.** 225) and a clinically identical condition of Corriedale lambs in Canada. On this basis they show the two conditions to be identical. Importance is attached to this since the view that "daft lambs" is an inherited condition (White & Rowlands (1945.) *Vet. Rec.* **57.** 491) is strongly supported by the proof presented by Canadian workers that the condition in Corriedale lambs is also inherited. A case of true cortical cerebellar abiotrophy is described and a comparison made with the changes noted in "daft" lambs, permitting the authors to regard the lesions in the latter case as a "toxic degeneration affecting the cerebellar cortex." Finally, the authors compare the neuro-pathological findings in two somewhat similar conditions likely to cause confusion in clinical diagnosis.

W. T. R.

*Cerebellar Disorders in Lambs. Babsiert, C. V., & Innes J. R. M. (1950.) *Arch. Path.* **50.** 36-62.

NOTES AND NEWS

Diary of Events

Jan. 16th.—Meeting of the Executive Sub-committee of the Editorial Committee, B.V.A., at 36, Gordon Square, W.C.1, 2 p.m.

Jan. 16th.—Inaugural and first meetings of the R.A.V.C. Division of the British Veterinary Association, at the Royal Veterinary College, London, N.W.1, 3 p.m.

Jan. 16th.—Annual General Meeting of the Royal Microscopical Society, at Tavistock House South, Tavistock Square, London, W.C.1, 5.30 p.m.

Jan. 17th.—Meeting of the West of Scotland Division, B.V.A. Clinical Club, in the Glasgow Veterinary School, 7.30 p.m.

Jan. 18th.—Annual General Meeting of the Mid-West Division, B.V.A., at Bristol (School of Veterinary Science, Park Row), 2.15 p.m.

Jan. 18th.—Meeting of the Yorkshire Division, B.V.A., at Leeds (Hotel Metropole), 2.30 p.m.

Jan. 19th.—Meeting of the Biochemical Society, at the Middlesex Hospital Medical School, London, W.1. 10.30 a.m.

Jan. 22nd.—Meeting of the East Midlands Division, B.V.A., at Sutton Bonington: 2.15 p.m.

Jan. 24th.—Meeting of the Western Counties Division, B.V.A., at Exeter (Imperial Hotel). 2 p.m.

Jan. 24th.—Meeting of the South-Eastern Division, B.V.A., at Maidstone (Royal Star Hotel) 2.30 p.m.

Feb. 1st.—Extraordinary General Meeting of Members of the British Veterinary Association, at the Connaught Rooms, Great Queen Street, London, W.C.2. 4 p.m.

Feb. 8th.—Royal Dick School of Veterinary Studies Annual Ball, in the Assembly Rooms, George Street, Edinburgh.

Feb. 14th.—Glasgow University Veterinary Medical Association Annual Ball, at The Rhul, Sauchiehall Street.

Quarterly Meetings of Council and Committees, B.V.A.

Wednesday, January 30th, 1952
11.0 a.m. Home Appointments Committee.
2.0 p.m. Organising Committee.
4.0 p.m. Parliamentary and Public Relations Committee.
At 36, Gordon Square, London, W.C.1.

Thursday, January 31st, 1952
10.0 a.m. Veterinary State Medicine Committee.
1.30 p.m. General Purposes and Finance Committee.
At 36, Gordon Square, London, W.C.1.

Friday, February 1st, 1952
11.0 a.m. Council Meeting.
At the Connaught Rooms, Great Queen Street, W.C.2.

(*See Col. 1 for entry re Extraordinary Meeting of Members, B.V.A.*)

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Veterinary Surgeons Act, 1881

Seventy years after the passage into law of the Veterinary Surgeons Act, 1881, there has been published by Messrs. Ernest Benn Ltd., a biography of A. J. Mundella, 1825-97, by W. H. G. Armytage.

The veterinarian looking through the index of this biography will not find any reference to the word "veterinary." Yet, the Right Honourable A. J. Mundella, M.P., was a good friend of the veterinary profession. In the text will be found reference to the fact that he was a member of the Select Committee of the House of Commons on the Cattle Plague in 1877, and it was due to his efforts whilst holding government office that the foundations of the present Ministry of Agriculture were laid. He was Vice-President of the Privy Council from 1880 to 1885, and it was during this period that he successfully guided through the House of Commons the first Act that gave some protection to veterinary surgeons.

The Annual Report for the Royal College of Veterinary Surgeons, 1881-82, tells the story:—

> "The Lord President of the Privy Council was successful in carrying the Bill through the House of Lords, and, at the earnest solicitation of the Lord President, the Right Hon. A. J. Mundella, Vice-President of the Privy Council, took charge of it in the House of Commons. Here it was most strenuously opposed by a large number of members the majority of whom, acting for the unqualified practitioners, were determined that the particular Clauses relating to these persons should be either altogether expunged or so altered as to be of little value to the profession; while other members, at the instigation of Members of the Royal College, opposed the Bill on the plea that it was unnecessary or did not go far enough. By the tact and determination of Mr. Mundella the Bill was carried through the House on almost the last day of the Session, and received the Royal Assent on August 27th. Had it not passed in 1881, it is extremely improbable that another Bill containing so many privilges would ever have been obtained, and those noblemen and gentlemen who were instrumental in having it inscribed in the Statute Book will merit the everlasting gratitude of the profession."

This biography of a remarkable man, the son, born in England, of an Italian father and Welsh mother, does not mention what he did at this period for the veterinary profession, and it is proper that his name should not be completely forgotten in this respect.

W. G. R. O.

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PERSONAL

Golden Wedding of Colonel and Mrs. P. J. Simpson

On behalf of their many friends in the profession, we would extend our heartiest congratulations, and good wishes for many further years of health and happiness, to our former President (1930-32) Colonel P. J. Simpson, D.S.O., T.D., J.P., F.R.C.V.S., and Mrs. Simpson, of Knowle Croft, Shoppenhangers Road, Maidenhead, who celebrated their golden wedding on New Year's Day. At a luncheon to mark the occasion held at the Riviera, Maidenhead, four of the five bridesmaids who attended Mrs. Simpson, then Miss Mabel Budgen, at the wedding at St. Luke's Church, were amongst the company of 46, who included, amongst many friends in the profession, Professor J. B. Buxton, Professor Geo. H. Wooldridge and Mr. H. Bell, together with the Mayor and Mayoress and Deputy Mayor of Maidenhead.

Both Mabel Budgen and Percy Simpson were born at Maidenhead, knowing each other at the kindergarten over 70 years ago. The families lived in the High Street and their fathers were well-known local men, both becoming Mayors of the Borough; Mr. Budgen founded the local grocery business and Mr. Simpson, like his father and grandfather, was a veterinary surgeon.

Colonel Simpson entered the veterinary profession from the London College in 1899, and during the first World War served with the Royal Army Veterinary Corps attached to the Berkshire Yeomanry: he won his D.S.O. while serving in Egypt. Among the offices he has held in professional associations is the Presidency of the Royal College of Veterinary Surgeons. His only son, Mr. J. F. Simpson, is a Fellow of the Royal College of Surgeons, practising in London.

At the end of his period of war service Colonel Simpson joined the local British Legion branch, served as President for a number of years and is now a life member; his wife is interested in the Women's Section. Over a long period he has been a mainstay of the Victoria Veterinary Benevolent Fund.

For many years he was a Territorial. During the last war he was responsible for the organisation of Maidenhead's A.R.P. Service and was its first Controller.

In the years between the wars both the Simpsons took part in concerts produced by local societies. Mrs. Simpson played the violin in the orchestra and her husband appeared in several of the Amateur Dramatic Society's productions.

The Colonel found time, too, to sit on the Magistrates' Bench; for 11 years up to December, 1949, he was Chairman of the County Magistrates. He was a Borough and County Councillor.

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CONFERMENT OF READERSHIP TITLES IN THE UNIVERSITY OF LONDON

Conferment of the following titles in the University of London is announced:—

Reader in Veterinary Bacteriology—on Dr. Reginald Lovell in respect of the post held by him at the Royal Veterinary College.

Reader in Veterinary Parasitology—on Dr. J. N. Oldham in respect of the post held by him at the Royal Veterinary College.

Reader in Veterinary Physiology—on Dr. H. F. Rosenberg in respect of the post held by him at the Royal Veterinary College.

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Saskatchewan V.A. Presidency for Mr. V. E. Senior, M.R.C.V.S.—Many of our readers will be interested to learn that Mr. Victor Edward Senior, M.R.C.V.S., formerly a Veterinary Officer of the Ministry of Agriculture in Great Britain, has been elected President of the Saskatchewan Veterinary Association. It was in 1947 that Mr. V. E. Senior left this country to join the Provincial Veterinary Service in Canada. Again to the regret of his colleagues, however, after two years he resigned his post as Veterinary Officer to take up private practice in Melville, Saskatchewan—an enterprise in which he has achieved marked success. His many friends in both countries will welcome this early recognition of his worth by the veterinary association of the province.

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Births.—ALLEN.—On January 3rd, 1952, at White Cottage, Colyton, Devon, to Pamela Margaret (*née* Wightman-Bell), wife of G. Sedgwick Allen, M.R.C.V.S., a brother for Jane—Mark Sedgwick.

GIBSON.—On January 2nd, 1952, at "Dell View," Wigginton, Herts to Joan (*née* Kress), wife of E. A. Gibson, B.SC., M.R.C.V.S., a son—John Edward.

SHORTER.—On January 1st, 1952, at the Hill Nursing Home, Reading, to Ann (*née* Wright), wife of David Richard Shorter, M.R.C.V.S., a son.

SKYRME.—On December 21st, 1952, at Wharenolie Hospital, Te Awamutu, New Zealand, to Ray, wife of Harold Skyrme, M.R.C.V.S., a daughter—Gillian Ray.

SMITH.—On December 29th, 1951, at Duke of York Home, to Pat (*née* Audrey Allom), wife of Douglas C. Smith, M.R.C.V.S., a son. Both well.

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Marriage.—COOK—GRIVE.—On December 22nd, 1951, at St. Mary's Church, Watford, Herts, Terence F. Cook, D.F.C., M.R.C.V.S., only son of Mr. and Mrs. F. Cook, of Bury St. Edmunds, Suffolk, to Betty Margaret Grive, S.R.N., only daughter of Mr. and Mrs. L. C. Grive, of Watford, Herts.

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Public Schools Rugby.—In the annual Public School boys' match, organised by the Richmond and London Scottish Football Clubs, played at Richmond Athletic Ground on Saturday, December 29th, 1951, R. S. Cochrane-Dyet (Blundell's) played open side wing forward for Scotland. Scotland won by 23 points to 5. R. S. Cochrane-Dyet is the youngest son of Mr. J. Cochrane-Dyet, M.R.C.V.S., St. Day, Cornwall.

R.C.V.S. OBITUARY

DORAN, James Charles, Fry Place, Athlone, Co. Westmeath, Eire. Graduated Dublin, July 21st, 1908. Died December 30th, 1951.

PARKIN, Bateley Scott, B.A. (CAPE), D.SC. (S.A.), Onderstepoort, South Africa. Graduated Dublin, July 13th, 1918. Died July 16th, 1951; aged 59 years.

THOMPSON, Joseph, Bank Buildings, Castlewellan, Co. Down. Graduated Glasgow, May 27th, 1890. Died December 8th, 1951.

MR. JAMES C. DORAN, M.R.C.V.S.

Mr. James Charles Doran, whose death we record above with much regret, died at Acres House, Roscommon. He was Veterinary Inspector for many years under the Roscommon County Council. Son of the late Mr. Thomas Doran, he was one of the best-known veterinary surgeons in the West and was prominently associated with all forms of sport, notably horse racing and coursing.

Professor Bateley Scott Parkin, B.A., D.Sc., M.R.C.V.S.

It is with much regret that we learn, from *The Journal of the South African Medical Association*, that Professor Bateley Parkin died unexpectedly at Enkeldoorn, Southern Rhodesia, on July 16th, 1951. In a tribute in the September issue of that journal "M. W. H." writes: "Bateley Parkin's death at Enkeldoorn, Southern Rhodesia, has deprived the veterinary faculty at Onderstepoort, and the profession as a whole, of one of its outstanding members.

"Bateley was born at Middleburg, Cape, on July 16th, 1892. His great-grandfather, John Parkin, emigrated to South Africa with the 1820 settlers and settled in Port Elizabeth.

"He studied at the Christian Brothers' College, Kimberley, where he matriculated in 1909, obtaining the Max Michaelis Scholarship. He then proceeded to the Rhodes University College, Grahamstown, where he graduated in Science in 1912. Soon after graduation he entered the public service and in 1914 volunteered for military service in S.W. Africa. A year later he was awarded a scholarship and proceeded to the Royal Veterinary College, Dublin. After a brilliant academic career, he graduated in 1918 and enlisted in the R.A.V.C. for service in the East. On his discharge from the Army in 1920 he returned to South Africa to take up an appointment as Lecturer in Veterinary Science, at first at Eisenburg and later at the Eisenburg-Stellenbosch Agricultural College.

"In 1927 he was appointed Research Officer at Onderstepoort and two years later Professor in Veterinary Medicine. In 1934 and 1935 he visited a number of veterinary institutions in Europe and America.

"In 1923 Bateley married Violet Cooper. They have one child, a daughter, Ethne, who recently obtained her M.A. degree at the University of Pretoria.

"Professor Parkin had always taken a keen interest in the practice of medicine and particularly in chemotherapy. The many facilities provided at Onderstepoort stimulated his interest and gave him the opportunity for investigating the value of many therapeutic agents and for introducing several new diagnostic methods into veterinary medicine. His contributions in this field, both published and unpublished, are outstanding and will remain a constant source of inspiration to his students and to those of us who had been intimately associated with him. Although gifted with a unique mental capacity, he was extremely modest and reserved and disliked any form of publicity. It was only in connection with his beloved golf that he revelled in relating his wonderful performances.

"No cause was nearer his heart than the welfare of the veterinary profession and he would unselfishly go to any trouble in endeavouring to serve its interests. Owing largely to his efforts the methods of training veterinarians in this country have been improved so much that the course at Onderstepoort compares most favourably with the very best elsewhere. Nevertheless he preferred to make his contributions incognito and would never accept any office or other reward.

"On account of his reserved disposition he remained in several ways a stranger to many of his colleagues and it is probably only his intimate friends and close collaborators who were fully capable of assessing the value of his manifold contributions to veterinary medicine and to the profession.

"Bateley also was a great sportsman. As a youngster at school he represented Griqualand West in cricket and in association football. Later he became a keen rugby enthusiast and there are probably very few supporters of our national game who had a better knowledge of the game and of the players who represented South Africa on various occasions. He was a very keen golfer.

"Owing to his sudden death we have lost a valuable colleague and a true friend, and we extend our deepest condolence to his widow and daughter in their bereavement."

UNIVERSITY OF LONDON EXAMINATIONS IN VETERINARY SCIENCE

Miss Margaret Treharne Williams, of the Royal Veterinary College, has passed the second examination in Veterinary Science, December, 1951: Veterinary Physiology only—to qualify for registration for Ph.D.

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ADDRESSES OF DISEASE-INFECTED PREMISES

The list given below indicates, first, the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

ANTHRAX:

Cheshire.—Pooltown Farm, Rivacre Road, Ellesmere Port, Wirral; Oaks Farm, Ledsham, nr. Chester (Dec. 31st).

Herefordshire.—Paunceford Court, Much Cowarne, nr. Bromyard (Dec. 31st).

Salop.—The Rowe Farm, Frodesley, Shrewsbury (Jan. 2nd).

Yorks (W.R.).—Claycliffe House Farm, Redbrook, nr. Barnsley (Dec. 31st).

FOOT-AND-MOUTH DISEASE:

Norfolk.—Beeches Farm, Pulham St. Mary, Diss (Dec. 31st); Post Office Farm, Forncett St. Mary, Norwich (Jan. 1st).

Saloop (E.).—Valley Farm, Sotterley, Beccles (Jan. 3rd); Vale Farm, Middleton, Saxmundham (Jan. 4th).

FOWL PEST:

Essex.—55, Newbiggin Street, Thaxted, Dunmow (Jan. 3rd).

Isle of Ely.—21, Upwell Road, March (Dec. 31st).

Lancs.—Alca, Shore Side, Heskett Bank, Preston; New House Farm, Chapel Lane, Newlongton, Preston (Jan. 1st).

Surrey.—1, Park Close, New Haw, Weybridge (Jan. 1st).

SWINE FEVER:

Beds.—New House, Radwell Road, Milton Ernest (Jan. 1st).

Durham.—The Allotments, West View, Hartlepool (Jan. 2nd).

Herts.—Holywell Farm, Watford (Jan. 2nd); Whittington, Hinxworth Road, Ashwell (Jan. 5th).

Isle of Ely.—17, Kings Street, Wimblington (Jan. 1st).

Lancs.—Kenacre Hall Farm, Renacre Lane, Halsall, Ormskirk (Dec. 31st); The Abattoirs, Lytham; Seftons Hall Farm, Upholland, Wigan (Jan. 5th).

Lincs (Lindsey).—Mill Lane, Woodhall Spa (Jan. 2nd).

Norfolk.—The Brickyard, Melton Road, Wymondham (Jan. 2nd); Holt Road premises, Mattishall, Dereham (Jan. 3rd).

Northants.—Cold Harbour Farm, Brackley (Jan. 4th).

Staffs.—The Kennels, Dunston (Jan. 5th).

Warwicks.—Valley Farm, Yarningdale Common, Claverdon (Jan. 5th).

Worcs.—Park House, Elmley Castle; Pear Tree Farm, Wythall (Jan. 2nd); Canal Side, Hopwood (Jan. 5th).

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THE ELECTRIC HARPOON IN WHALING

HUMANITARIAN AND COMMERCIAL SIGNIFICANCE

Our readers will find of interest the following communication to *The Times*, from "A Correspondent," as supplementing the absorbing account of his experiences of Antarctic Pelagic Whaling (reproduced in our issue of February 17th) by Mr. W. Ross Cockrill, in an abbreviated version of his thesis successfully submitted for the R.C.V.S. Fellowship diploma.

A technical innovation in the whaling industry that may have important and beneficial effects, both from the humanitarian and the commercial point of view, is the development of the electric harpoon, which has lately reached the practical stage.

By the method now in general use, the explosive harpoon, which wounds but rarely kills outright, the killing of a whale is usually a long and cruel business. When the animal is struck it first sounds—that is, dives—and then comes to the surface and tows the catcher, a ship of 300 tons or so, until exhausted by loss of blood. The laceration by the shell, and perhaps the fatigue and pain, adversely affect the quality of the whale meat, which is now of considerable value. A certain number of whales so killed sink and are lost. On the other hand a whale struck by an electric harpoon is instantly immobilised and dies at once, or within a few minutes, with the meat intact.

Commercially the greatest advantage of electric whaling is the saving of time. The number of whales which may be killed in a season by all the whaling fleets together is limited by international convention to 16,000 Blue-whale units, a Fin whale being reckoned as half a Blue whale, a Humpback as two-fifths, and so on. The fleet which catches most rapidly catches the largest number of whales, since all whaling ceases when the prescribed aggregate has been caught. The general adoption of electric whaling might mean that the whaling season could open later in the year, with the result that, since whales are thin at the beginning of the Antarctic summer and put on fat through the season, each whale caught would yield more blubber and so more whale oil.

Such considerations are important in the conservation of whales. The fate of the Greenland whale, which is now very rare in British waters though it was fished regularly from Whitby and Dundee in the 19th century, is a reminder that over-fishing involves something like extermination.

Electric whaling consists in causing a strong electric current to pass through the whale from an alternating current generator on the catching vessel by way of a conductor embedded in the forerunner (the rope attached to the harpoon), the return path being provided by the sea. The chief technical difficulty arose from the introduction (just when recent experimental work was beginning) of nylon forerunners. These are much stronger and lighter than the old hempen ropes, but they can stretch up to 40 per cent. of their length. The conductor embedded in them must therefore be equally elastic, besides being insulated and carrying a current 20 times as strong as that in an ordinary electric light flex. This difficulty has been overcome by the General Electric Company of England in collaboration with British Ropes Ltd., of Leith.

As always when a new method is ready for introduction, the question arises whether old equipment can be adapted for use during the transition. In the present instance it is possible, as an interim measure, to retain the Svend Foyn gun, which is mounted on every existing catcher, and to use it for firing a heavy harpoon, but attached to a forerunner embodying an electric conductor. This arrangement has ballistic disadvantages like those of the explosive harpoon, but it has two advantages. First, it can be installed now. Second, existing guns need not be scrapped. A lighter harpoon, fired from a special gun with a high muzzle velocity and a flat trajectory, has been designed, and is in a late state of experimental development by Westley Richards & Co., Ltd., but even when it is ready the process of installing it may take some time. The same electrical gear will serve either the heavy or light harpoon.

Some experimental work in electric whaling was done in Norway in the twenties, and much progress was made there during the war under a Nazi engineer named Weber, who committed suicide after the German defeat. In 1947 Commander F. Simon mentioned the possibility of electric whaling in a letter to *The Times*. In the same year Dr. Harry Little, of the Universities Federation for Animal Welfare, returned from serving as a surgeon in a whaling fleet full of horror at what he had seen. After a meeting of experts at University College, London, in October, 1947, collaboration was arranged between United Whalers, Ltd., and the General Electric Company of England, and a catcher was hurriedly equipped for trial during the Antarctic whaling season of 1948-49.

The next season two electric catchers were fitted out, and Sir Vyvyan Board, Chairman of the Directors of United Whalers, Ltd., went to the Antarctic to supervise further trials, accompanied by Mr. Robert Marsden, of G.E.C. In 1950-51 there were five electric catchers in the Antarctic.

DISEASES OF ANIMALS ACT, 1950—GREAT BRITAIN

Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period	Anthrax	Foot-and-mouth	Fowl Pest	Parasitic Mange*	Sheep Scab	Swine Fever
Dec 1st to 15th, 1951	20	28	32	—	3	45
Corresponding period in—						
1950	13	—	13	—	2	46
1949	7	—	16	—	8	—
1948	9	1	5	—	4	—
Jan. 1st to Dec. 15th, 1951	387	98	816	—	11	1,302
Corresponding period in—						
1950	331	20	133	—	26	376
1949	224	15	574	—	42	5
1948	110	12	259	1	64	27

* Excluding outbreaks in Army Horses.